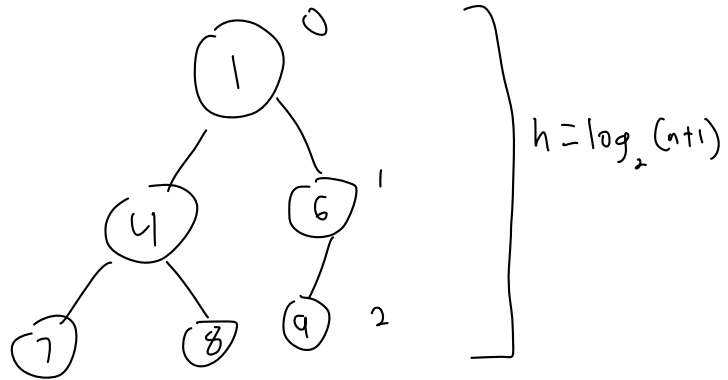


Heaps

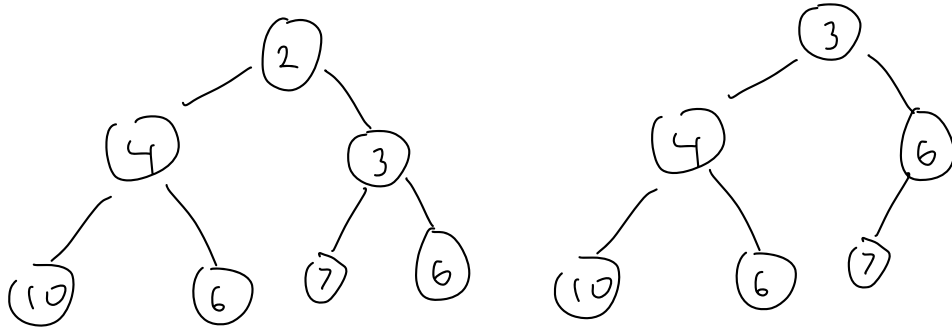
- Complete Binary Trees



insert(2) $O(\log(n))$

insert(6) $O(\log(n))$

removeMin() $O(\log(n))$



Heap - Sort

[5, 7, 2, 1]

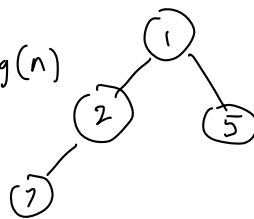
insert(5)

insert(7)

insert(2)

insert(1)

$n \log(n)$



removeMin()

removeMin()

removeMin()

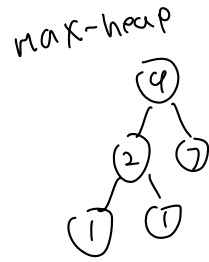
removeMin()

$n \log(n)$

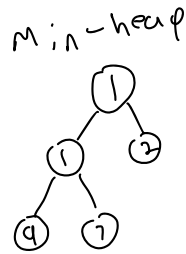
$2(n \log(n)) = O(n \log(n))$

[1, 2, 5, 7]

1. At which nodes of a max-heap can an entry with the largest key be stored? What about a min-heap?
2. At which nodes of a min-heap can an entry with the smallest key be stored? What about a max-heap?



largest key is at the root
min key is at a leaf node



largest key is at a leaf node
min key is at the root

(23, 15, 3, 7, 44, 9, 8, 1, 12)

selection sort - $O(n^2)$

insertion sort - $O(n^2)$

heap sort - $O(n \log n)$

quick sort